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ABSTRACT

This autoinstructional unit deals with the identification of units of measure in the metric system and the construction of relevant conversion tables. Students in middle school or in grade ten, taking a General Science course, can handle this learning activity. It is recommended that high, middle or low level achievers can use the program. Eighteen minutes is the suggested time needed. Three behavioral objectives are given and the equipment and materials needed to help the students achieve the objectives are listed. A student guide and a vocabulary list are also included in the packet. (EB)

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METRIC SYSTEM

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A-T TEACHER'S GUIDE

Packet Number - AT 389.152
S

Subject - General Science

Grade - Middle School and Grade 10

Level - H M L

Prerequisites - mathematics of fractions and decimals

Behavioral Objectives -

1. Given a list of the following words; liter, pound, gram, quart, meter, and yard, the student should identify which word measures mass, volume, and length and which system, metric and English, each word belongs.

2. Given a list of metric prefixes; milli-,centi-, deci-, Deca-, Hecto-, and Kilo-, and basic unit (liter, meter, gram), the student should write each metric unit in its fractional and decimal form, and he should construct three conversion tables, one measuring length, one measuring mass, and one measuring volume, using base ten.

3. Given a metric conversion test, the student should correctly solve ten out of fifteen problems.

Equipment and Materials - (*included in packet; **must be prepared in advance)

**laminated papers to be posted in carrel (metric prefixes, meter-metric length, liter-metric volume, gram-metric mass, AA,BB)
* papers A through K in envelope
**envelope X - test
**scrap paper
* Script
* Student guide
* Vocabulary list
*Cassette tape
* Slides - 5
**Slide Viewer

Time - 18 minutes

Space Required - _____carrel _____other

NOTE:(Carrell must be provided with 110-120 v, 60 cycle electricity)

METRIC SYSTEM

Today you will begin the first of several tapes on the metric system. You will learn how the system developed and how to convert from one metric unit to another metric unit. If you do not understand any part of the instruction, you can always rewind the tape and hear it again. Occasionally, you will hear a short interlude of music, stop the tape and carry out the instruction as indicated then proceed with the tape.

Suppose you have just returned from a fishing trip. A friend asks you if you caught any fish and the length of the longest in the catch. You would probably answer by holding your hands apart, perhaps 12 inches or more. If your luck was poor and you caught a small fish, you probably show the size by holding two fingers close together.

Would you have trouble describing the exact size of the fish? Yes, you would. To be more exact, you would use a standard of measurement, such as a foot. A standard is simply a convenient basis which is set-up and established by authority as a rule of measurement.

The standards of measurement used today can be traced to ancient units of measurements. Turn the viewer to slide one. Read the caption. Before the present units were standardized, the ancient units of measurement were compared with the parts of the human body. For example, an inch was the breadth of the thumb, a mile was 1,000 paces, a span was the distance from the tip of the thumb to the tip of the little finger when the fingers were spread apart, and a palm was the breadth of four fingers held together. Turn to slide two. At one time the common unit of measurement was the king's foot. What would happen to the length of the foot, if the king died? When the new king took his place, the unit of measure was changed. This created a great deal of confusion. It was hundreds of years before it was decided that measurement should be standardized to give the same measurement, no matter who became king.

The units were standardized, but the units did not add up to even sums. A fish might be longer than one foot, but shorter than two. The problem was solved by using fractional parts of the foot, and the fish was said to be one and one-half foot long. However, working with fractions is often cumbersome.

A completely new system of measurement was worked out, and it was called the metric system. The relationships between the units are much simpler. The unit of length in this system is the meter. This corresponds, as you know, to the yard in the English system. A meter is approximately one forty millionth of the distance from the North

Pole to the Equator. Because this distance does not change, it is much easier to use than the dimensions of the foot, hand, thumb, or palm. It was Delambre and Mechain who measured a portion of the unit meridian; that is, the meridian that passes through Dunkirk, France and Barcelona, Spain. After seven years of measuring, these men presented the French Academy of Science with a standard meter made of platinum and iridium. This meter is now kept in Sevres, France. Turn to slides 3, 4, and 5 and read the captions.

In 1960 an International Bureau of Weights and Measures changed the standard meter to a multiple of wave lengths of the orange-red line spectrum of gas, krypton-86. The standard meter is now 1,650,763.73 times the wavelengths of this gas.

The unit of volume in this system is the liter. What units would measure liquids in the English system? You might say fluid ounces, cups, or gallons, but the standard is the quart. The kilogram is the standard unit of mass, and in the English system, it is the pound.

Let's recall some of the unit names that identify mass, volume, and length. You may have mentioned ounces, pounds, or tons for mass; inches, feet, yards, or miles for length; and fluid ounces, cups, pints, quarts, or gallons for volume. Notice the units are all different. This is not so with the metric system. This system combines specific prefixes with the name of the basic unit, whether that is gram, liter, or meter, to show the size of the unit. Let's review. What is a prefix? That's right. It is something which goes in front of the root word. The ones which are frequently used are milli-,centi-, deci-, Deca-, Hecto-, and Kilo-,. Milli- is the smallest unit prefix. Each prefix after milli- is larger with Kilo- the largest. In the envelope, find the paper labelled A. Look at each prefix. The prefix, milli-, means one-thousandth. How would you write it? That's right. You could write it as 1/1000 or as 0.001. Remember either form is correct, only the first is a fraction while the second is a decimal. Let's do the next prefix, centi-. Turn off the cassette and try to work the problem then check your answer with the tape. Use scrap paper in the envelope. The prefix, centi-, means one-hundredth. It can be written as 1/100 or as 0.01. How would you express the basic unit? As we have stated, the basic unit for mass is the gram, for volume is the liter, and for length is the meter. We can express the basic unit in a fractional and decimal form. The fractional form is 1/1 and the decimal form is 1.0. How would you express the prefix, Deca-? The fractional form of Deca- is 10/1 or 10 and the decimal form is 10.0. Take the paper labelled B from the envelope. Study the prefixes. Notice that the prefixes, milli-, centi-, and deci-, are expressed as one over some multiple of ten while the prefixes, Deca-, Hecto-, and Kilo-, are expressed as some multiple of ten over one. Remember milli- is the smallest prefix. Each prefix after milli- is larger with Kilo- the largest. When you can express each prefix in its fractional and

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page 3

is 80 dl equal 8 liters because 8 times 10 dl equal 8 times 1 liter. Let's try several problems. Look for the paper labelled G. This paper has four problems. Work each problem carefully. The answers and solutions are found on paper H. Make certain you understand how the answers evolved before going on.

Suppose that a length of an object is 14 cm. This amount could also be written as 0.14 m or as 140 mm, because the units of length in the metric system are related by powers of ten. Thus, it is possible to convert from one unit to another unit by merely moving the decimal point in the proper way. For example, in converting from 0.14 m to mm, the decimal point is moved three places to the right. However, in converting from 140 mm to meters, the decimal point is moved three places to the left. An easy way to do this is to write down all the prefixes, including the basic unit from small to large - or milli- to Kilo-. If you go from a small unit prefix as milli-, to a larger unit prefix, as Kilo-, or down the scale, you move the decimal point to the left. If you go up the scale, from a larger unit prefix to a smaller unit prefix, then you move the decimal point to the right. Think of the turn signals on an automobile. Push the indicator up and you signal for a right turn; push the indicator down and you signal for a left turn.

Okay so far. You now know down the prefix scale, move the decimal point to the left; up the prefix scale, move the decimal point to the right. These are posted as AA and BB. How many places do you move the decimal point? You move the decimal point the number of places you go up or down the prefix scale. For instance, you want to change 2,000 mm to Kilometers. Find the paper labelled I in the envelope. Notice that the problem is written first, then the prefix scale, including the basic unit, meter. Also note that you are going down the scale and will move the decimal point-to the left. From milli-, to centi-, is one decimal place, from centi- to deci- is another or a total of two decimal places, from deci- to the basic unit, meter, is another decimal place or a total of three, until you come to Kilo- or a total of six decimal places to the left. Two thousand mm means 2000.0. The problem is asking you to express this in terms of Km. The next step is easy. Just move the decimal point six places to the left or 0.002000 as you can see on paper I.

Try the three problems on paper J. The answers and solutions are on paper K. When you have succeeded with this tape, you may rewind the tape, return the viewer to slide one, and place all papers in the envelope in the order you found them. In the envelope marked "X" you will find one out of a possible five tests. Remove the test, follow its directions, and return it to me.

STUDENT GUIDE

INTRODUCTION
METRIC SYSTEM-HISTORY
METRIC CONVERSIONS

Use this guide to write any notes or comments you wish to keep from this experience.

1. Given a list of the following words, liter, pound, gram, quart, meter, and yard, the student should identify which word measures mass, volume, and length and which system, metric and English, each word belongs.

2. Given a list of metric prefixes, milli-, centi-, deci-, Deca-, Hecto-, and Kilo-, and basic unit (liter, meter, gram), the student should write each metric unit in its fractional and decimal form, and he should construct three conversion tables, one measuring length, one measuring mass, and one measuring volume, using base ten.

3. Given a metric conversion test, the student should correctly solve ten out of fifteen problems.

Take out a pencil; put on the headphones; turn on the tape player; and follow the taped instructions.

VOCABULARY LIST

Foot - length of living king's foot

Gram - standard unit of volume in metric system

Inch - breadth of thumb

Line spectrum - range of color

Liter - standard unit of volume in metric system

Meridian - imaginary line that passes through the poles

Meter - standard unit of length in metric system

Mile - 1,000 paces

Palm - breadth of four fingers held together

Prefixes - something which goes before the root word
Metric prefixes:

milli-	0.001	Leca-	10.0
centi-	0.01	Hecto-	100.0
deci-	0.1	Kilo-	1000.0
Basic Unit	1.0		

Span - distance from tip of thumb to tip of little finger when fingers are spread apart

Standard - basis which is set-up and established by authority as a rule of measurement